Inventing

as a way of life.

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with Dan Koger and Connie McAlindon

Chapter 1
Becoming an Inventor

I don't know if I was born an inventor, but I certainly began showing signs of creativity at an early age. Maybe geography had something to do with it.

My family came from Norway in the mid-19th century. My mother and father met in Minnesota, but moved to Canada before I was born. I was born in Canada and because my parents were both American citizens, I have always had dual citizenship.

I grew up in Sceptre, Saskatchewan, a town of about 350 persons on the vast Canadian prairie. Sceptre was surrounded by thousands of square miles of prairie grass and wheat fields. The land couldn't have been flatter. The only vegetation that could be remotely accused of being a tree was the hardy caragna bushes that pushed up out of the hard prairie ground, and these were never more than about 6 feet tall. The winters were callously cold; temperatures could sink to 60 degrees below zero and with the good stiff breeze, we sometimes had a wind chill factor of about minus 150.

Our large frame house was on the edge of town, like the homes of everyone else, and that was where civilization met an ocean of prairie grass. I was born on the front porch in 1916.

I think those isolated surroundings in rural Saskatchewan influenced me to become creative, as well as inventive. There weren't a lot of diversions for young boys in such a remote area. What amusements we had were self-made, a reality that put creativity at a premium. We had to make our own arrow guns, sling shots, airplanes and other toys out of wood and rubber bands.

Donald, my older brother, was an excellent wood carver. He would take a piece of wood, whittle for a few minutes, and end up with a perfect airplane propeller. I couldn't do that.

The first inventive act I remember was when I was about 8 years old. Donald and I would ride on horseback to a neighbor's house to pick up fresh bread. The horse would smell the bread and try to follow it. Since I was on the horse's back carrying the bread loaf under my arm, this presented a serious problem for me - and for the horse. He seemed determined to double back on himself in pursuit of what his nose told him was good eating. The only way to make the horse go straight was for me to lead him, an alternative that obviously defeated the purpose of riding the horse to the neighbor's house in the first place. It would have been easier to walk; even my 8-year-old mind was clear on that concept. It was evident that I had to find

a way to correct the horse's motivations, something I did with a bamboo fishing pole, some line and my imagination.

I invented my way out of a difficult situation. My plan was simplicity itself. I hung the bread from the fishing line at the end of the bamboo pole.

Then I held the bread in front of the horse's nose and let him follow the smell back to the barn. Such inventiveness, as it turned out, was to become normal behavior for me.

Because we had to get the best possible use out of what toys we had, I found myself spending a great deal of time with the erector sets my father bought me over the years. I really had one erector set that kept getting bigger as my father gave me additional pieces. I spent countless hours bolting the pieces into creative constructions.

We had a large cellar under the house and because it was warm and dry, I used to spend much of my free time there during the winter. Dad had one of the few cars in town and its battery was stored in the cellar for the winter as part of the Canadian cold weather ritual. Cars were drained of their radiator water, put up on wooden blocks and relieved of their batteries for storage indoors.

I got a bright idea - why not has the only doorbell in town, an electric one at that. I scrounged an old Ford automobile coil, some discarded distributor points, and the bells off a broken alarm clock. I combined these with our car battery and some inventiveness, and we had our doorbell. Of course, it could only be used when the car was stored for the winter.

That was one of the fairly benign applications of my expertise with the car battery. There were others. For example, there was the time I hooked up the battery and the Ford coil to a metal gate in our front yard. I rigged a switch on my creation. That way I could hide behind a bush waiting for visitors to arrive. When they touched the gate, I'd hit the switch. The visitors then got what was probably the first shock of their lives - being that there was no electricity in town. I had lots of fun, until my parents got wise. They didn't see the humor in watching people get their first lesson in electricity in the Hougen front yard.

Along with the expanding erector set, my father bought me the Books of Knowledge. I loved those books, especially the science in them. My father got them for everyone to use, but I was the one who took advantage of the opportunity. The countless hours spent reading those books must have given me the equivalent of a good many college credits. The knowledge acquired from the books provided much of the foundation of information that later made it easier for me

to invent.

My parents went to Saskatchewan to homestead in 1914. My father got half a section of land and put a sharecropper on it. He then took a job managing a lumberyard in Sceptre. We lived in town, but there were always ponies and lots of dogs and cats around.

Between the farm and my father's business, my brother, Donald, and I kept busy. We to take care of two milk cows that we kept in a small barn behind the house. That was great in the summer. When it was warm. But in the winter, when the temperature hit 50 or 60 degrees below zero, it was less than thrilling. We had to walk half a mile to the water well because it was too cold to ride, and if we were the first ones there that day, the trough could have 6 inches of ice on it. Something as simple as taking the cows and ponies out to drink was hard work.

We did not get an allowance for doing our chores at home. That was something that my parents didn't believe in. If we wanted spending money, we had to get out and earn it ourselves. Along with the lumber business, my father was a coal dealer. When I was in high school, I would be given the job of shoveling coal out of the railroad cars and into storage sheds. I was paid 10 cents a ton. At best, I could shovel 35 tons of coal a day, an effort that brought me the handsome salary of $3.50 per day. The coal we sold was all the soft variety. It seemed to me that the soft coal jostling around in a freight car for many, many miles ended up a pile of dust on the rail car floor. I would unload the coal scoop by scoop into a wheelbarrow, push the wheelbarrow down an incline, and come to an abrupt halt, tilting and raising the handlebars to spill the coal and some of the dust into the storage shed. The wind seemed to be always blowing straight back at me. After 15 minutes, I would be covered with coal dust and getting cleaned up afterwards was a constant challenge.

The water supply was limited to only one town well located about one-half mile from our house. If we used up the water, we had to go for more. The well water was primarily for drinking; it was used for washing only when the rain cistern was empty. Our cistern was in the cellar and holds about 3,000 gallons, but it never lasted through our cold winters. It was easy to understand why people only had washbasins and not bathtubs. Anyway, aside from the clean-up problems, I considered the coal shoveling job pretty good, especially when a bank wanted to hire me, but could only pay $18 a month. At that rate, I was ahead shoveling coal, dirtier, but financially better off.

Another early moneymaking venture for me was when I organized a five-piece band. It was a pretty good band, other than the

occasional screech from Cecil Grist's violin, which told me Cecil's padless fingers needed more talcum powder. The ends of his fingers were cut off in an iron gate when he was a young boy in England. Having only skin on the ends of his fingers didn't bother his playing the bones - he was an expert - but the violin sure complained when the skin on the ends of his fingers got damp. The band paid a lot better for the time spent than shoveling coal. We got $3 a night, but we could only get one night's work in a week. The hard work and the comparative isolation taught me self-reliance and the benefits of an active mind. There was no one else to think for me.

My brother Donald's employment experience was similar to mine. He tried earning money by joining a wheat threshing crew. The pay was $2 a day. That career lasted only one day for him because after a sleepless night in the barn, he was so infected with bed bug bites that he had to quit. Another way Don earned money was by snaring gophers. The Provincial government paid a 5-cent bounty for the little animals, collectible when their tails were turned in. I believe the area around Sceptre was unique in that it had a lot of tailless gophers running around. Don would cut their tails off for the bounty and then turn them loose.

Donald was a rebel - a radical all his life. He was a daredevil and a fighter in spite of his slight build. His eyes were slightly almond-shaped, making him look vaguely Oriental. Floyd Sage, the butcher's son, and Don fought almost every day after school. The battle would rage when Floyd called Don "Chinkee, Chinkee Chinaman." The next day Don would call Floyd "Sausage Grinder" and the fight would start again. Don was outweighed by almost 20 pounds and always came out second best, but that didn't stop him from calling Floyd names. Donald's nickname kind of pleased him. He was called "Moonshine," and I was called "Sunshine."

At the age of 12 or 13, Don started serious smoking and could roll a Bull Durham cigarette while riding horseback. He ran away from home when he was 15 and got about 100 miles before he was picked up and sent back home. That same year, in the dead of winter on a 20-below-zero day, he ran away for good. He hid in a freight engine tool box and got as far as Windsor, Ontario, about 600 miles east. From there he sneaked across the border and went to Chicago, where he nearly starved to death that winter. The next summer, he joined the merchant marines. The following fall we heard from Don when he sent us a fez from Turkey, along with pictures of him on a camel near the pyramids in Egypt.

Don never married. He became a highly skilled trade worker and

earned a considerably better-than-average living working half a year and vacationing half a year, mostly in Mexico. He had a different woman each year in Mexico. He died of emphysema and congestive heart failure at 68. Everything Don was good at I was bad at. Everything Don liked I didn't and vice versa. For instance, I was good at math and Don did poorly. I loved growing up in Saskatchewan and he hated it. Who's to say who had the happier life? I know I have and I know he felt he did.

So, the isolated environment forced me to find imaginative ways to entertain myself and to accomplish simple tasks like transporting freshly made bread by horseback. But, I also think heredity had something to do with my inventive tendencies.

Who knows, maybe I inherited some of my creativity from my father's side of the family. After all, through him, I am blood relative to one of the foremost economic thinkers of this century, Thorstein Veblen. Veblin, who was also a social critic and author, was my grandmother's brother. Although I didn't agree with some of his views about life in America, I respect him as an academic observer, thinker and analyst and I would like to have known more about him. He never visited us way up in Canada, so I never saw him, but I heard about him from time to time during family discussions. I have always had a lot of pride in knowing such a thinker was part of Don's and my heritage. I know Don got the radical genes, and perhaps I got the creative ones.

My mother was, in her own right, a creative person, and very independent. She didn't have to work. My father's comparatively substantial income as a small-town lumber dealer and building supplier, along with his astute investing, assured us all a degree of security. But my mother still found plenty to do all her life. When she was 45, she insisted on buying property in a national park in the northern part of Manitoba. There were guesthouses near the property, which she began buying until she owned five. Each summer for years, she would go up there and rent out the houses. She took care of them with minimal help. They were large, beautiful old homes, the kinds of places that take lots of effort to maintain properly, and she kept them in perfect condition until she was over 80 years old.

For the last 45 years of her life, my mother would winter in Florida, driving down by herself from Canada. The 2,000 mile drive never seemed to bother her. She liked to drive fast, so maybe the challenge of distance and speed kept her from being bored. Also, maybe she developed an approach to creativity that was to serve me well over the years. Finding good places to think isn't easy in our

hectic world, and inventors need long stretches of quiet time to play with their thoughts. One of my favorite thinking places is in the automobile, on long trips across relatively empty spaces. Maybe my mother shared the same need for quiet time behind the wheel so she could plan her investments. The last couple of years of her life she had to have help with the trip, but she still went.

My mother was an excellent artist and a good investor in the stock market, an avocation that earned her quite a bit of money during her life. Unfortunately, she had a soft side. Some people took advantage of her generosity. For example, she once lost thousands of dollars in a gold mining investment and another large amount in financing an incompetent individual in buying an auto dealership. Still, she had a good sum of money when she died at 87.

My father worked for the Beaver Lumber Co. In the Depression he was offered the choice of working for a commission or a salary; he wisely accepted the commission. He was able to run the lumberyard as a business venture, and because he was a good salesman, accepting the commission offer turned out to be a smart decision.

My father had quite an influence over my attitude toward money and what could be done with it. He showed me the value of investing. I would often overhear my father talking long distance to his stockbrokers and to my mother about stocks. I'm sure that accounted for my later interest in stock market investments. Investing in the stock market was a way of life for our entire family, including my brother Don. Dad also bought stocks on the margin, something I have never don. Between the great stock market crash and the bank failures, my parents lost everything they had. But before Dad died of a heart attack at 53, he had re-amassed a large amount of money. He was a self-made man, and I found it natural to want to do the same. Dad's flare for picking good investments perhaps rubbed off on me. He was more of a gambler than I am, in that he would invest on borrowed money, whereas I do not.

My powers of concentration were great and still are. Some say simple-minded people are capable of longer concentration spans. Maybe growing up without a lot of toys was part of it. I had to sit and concentrate to entertain myself. My parents had a lot of confidence in me, and I had a bit of audacity. My father always told me, don't tell someone you can't do a job. Intimate you can and then go home, bone up on it and after you get the job, work twice as hard as anyone else would. That's how I got my first job at General Motors Institute. I hinted I knew more than I actually did. I wasn't looking for an auto body repair job. I was looking for a way to earn

a living. When I got the job, I did work twice as hard as expected. My pay was 30 cents an hour. A great plus of the job was that I could attend all the evening classes I wanted, tuition free. I took full advantage of this opportunity. GMI was and still is one of the finest engineering and technology schools in the country. I was fortunate to have this fine institution at my disposal so early in my career.

I realized at an early age that I would one day leave Canada to make my way in the world. I could have stayed and managed the lumberyard like my father, but I didn't see much challenge in that. I wanted more but wasn't sure what that "more" would be.

Close family friends, a shoe and harness maker and his family, the Coxworths, were influential in my coming to Flint. My family got word from them about the financial benefits of jobs there. So that's where I decided to begin making my fortune. The move to Flint led to my involvement with the auto body repair business and ultimately to my inventions of many auto-related devices and tools for auto manufacturing.

Leaving Canada was traumatic. Left behind would be my friends, my parents and a country that had been good to me. It was painful at the time, but I adapted. Looking back now, I can say that I wouldn't trade my childhood and teens with anyone. I am not the slightest bit jealous of the kids that grew up in metropolitan areas. I had all the advantages, not them, even though I lived far off in the country. Making a fortune - and I always felt I would - seemed a sure thing in the land of opportunity, the U.S.A.

I had finished two years of business school through a correspondence course and already decided I had to go out on my own. The only question I had left was where I would go. Word from Flint and the potential for work in the U.S. automobile industry was all the incentive I needed. Flint seemed as good a place as any to seek my fortune, especially when I could stay with friends for a moderate sum of money.

A relatively young man, Bob Short, who had left for Chicago 10 or 12 years before and had become financially successful, offered me a ride out of Canada. In 1936 we drove his brand new Desoto to Chicago. From there I took a bus to Flint, where I was given lodgings with the Coxworths. Nobody could have treated me better than they did. Morris and Margaret and their parents treated me like family. Mr. Coxworth had become successful in Flint since leaving his harness and shoemaking trade in Sceptre.

Unfortunately, when I got to Flint, a job wasn't waiting for me. So I spent the first few months hunting for one during the day, attending

a variety of classes at GMI in the evening, and doing the only thing I could to make money - playing the sax.

It was several months before I got full-time employment; and when it happened, I was offered two different jobs the same day. One was as a clerk in a clothing store, the other, the one I accepted, was an apprenticeship at GMI. It was great to have full-time employment. Playing the saxophone was not very lucrative. My musical talent was practically nil. I was self-taught, practiced a lot, and played mediocre at best. Even so, it was an experience I valued and enjoyed. I can't help but wonder sometimes what would have happened had I taken the job in a haberdashery. I might never have invented.

During my apprenticeship at GMI, Charley Mobley, one of my instructors, told me he thought there was an opening in the Product Service Department. He took me over and introduced me to another instructor, who headed up a section in the dealer co-op program. Charley, who later became the mayor of Flint, was a great guy. The very talented instructor who hired me, Lucian Skidmore, gave me a fine start in my trade and let me innovate on techniques that later put me in good stead. Years later, Skid, as everybody called him, came to work for me as a salesman and demonstrator. He did an excellent job.

I've been fortunate in having such a fantastic and supportive family and being associated with and helped by many talented people. My sons, Doug, for example, had been a teacher for 13 years when he came to work as president of Blair Equipment Company - my first company that I gave my four sons. Through Doug's excellent management capabilities, business doubled for the company in less than five years. My other three sons did well also. Randy has worked his way through the ranks and has recently been named executive vice president for Hougen Manufacturing. He is also president of Blair. Victor, the audio visual department director at Hougen, is the artist in the family and puts his creative talents to work producing top-notch audio visuals to use in our marketing campaigns, and Bradley maintains the vehicles and manages any other mechanical needs of both companies.

Besides a supportive family, I had some outstanding friends and associates. There was once a General Motors vice president who wouldn't let me sell my product to GM wholesale because he said I needed the money to help ensure that my business was a success. I was still working for GM at the time. Incidentally, he also suggested the name for Blair Equipment Company after the street where I lived.

I apprenticed at GMI for two years and then was offered jobs at

dealerships in New Rochelle, N.Y., and Indianapolis, IN. It wasn't a difficult decision. New Rochelle is in one of the most exclusive counties in the country and was only a half hour train ride from Times Square, where my brother, Don, lived. Later, Don was to show me how to enjoy New York. A nickel subway ride would take us to any of the city's five boroughs, often in pursuit of free dances. To the small-town boy from Canada, New Rochelle and nearby New York City were fantastic places for a 22-year-old to be.

This dealership had the exclusive franchise in the area for Buicks. I worked on a 33 percent basis, an arrangement that earned me lots of money as a body man. We had some famous customers at the dealership, among them the millionaire playboy, Tommy Manville, and baseball legend Babe Ruth. The Babe came into the dealership one day to visit his close friend E. V. Derks, the owner. Ernie came to me and said "Hey, Doug, recognize this guy?" I answered no. He said, "You mean you don't recognize Babe Ruth?" I was pretty embarrassed, but after all, I was a Canadian and hockey, not baseball, was my game. Besides, The Babe had been retired for three years. Tommy Manville, the often-married, super-rich eccentric, once was so pleased with a repair job that he gave the mechanic a car. Unfortunately, I wasn't involved in that particular job.

I had to prove myself at the dealership in New Rochelle, a requirement that gave my inventiveness a real test. I started with only some basic tools I had brought with me. I told the owner that a body man needed at least $1,000 worth of tools to work effectively. The owner said, "See that car? That's the car you're going to straighten, with the tools you've got and the ones we already have. You do that job in a reasonable amount of time and I'll buy you any tools you want."

Well, I straightened the car. It was a big Buick limousine that had been parked on a hill and had rolled backwards into a tree. The impact squashed the rear end. I was supposed to pull it back into shape, and all I had to work with were car jacks, ordinary metal pipe, chains and a big tree in the parking lot. I did the job, improvising tools and methods. When I was finished, the car looked like it had never been hit.

I made more money than anyone else in the garage, primarily because I did things faster than anyone else. In an hour, I could finish a job that was estimated to take three hours. I worked faster because I developed tools and methods to straighten metal more efficiently. I was never content to operate in the traditional way, just because that was how things had always been done. I figured out

better ways. Being of slight build was also helpful; I was forced to be creative in order to get the job done.

It was in Westchester County, New York, in 1939 that I met my wife, Teri. That was another bit of luck and, of course, good taste on my part. I rented a room from Teri's family. Her father was a barber who operated a small, yet successful contracting business on the side. He was a fantastically interesting character who years later became a valuable employee of Hougen Manufacturing. He easily adapted from working with wood to working with steel and ended up enjoying the new challenge.

Members of the Perrault family were and still are a bunch of characters. Jerry, Teri's older brother, was a maitre d' of the world's largest nightclub, Meyers Parkway Inn in the Bronx, when I met him. His conflicts with a union that wanted to organize the club were solved so successfully that the union eventually hired him. He stayed a union leader until he retired a couple of years ago. Roger, Teri's younger brother, is a carpenter. He and Jerry secured their futures with hard work and astute investments in income property.

Teri is also a character, with an excellent sense of humor. You couldn't ask for a better conversationalist. She is a fantastic mother and wife and her compassion and generosity led her to start the Hougen Foundation. This and other accomplishments have earned her a listing in Who's Who in American Women. Going to a Perrault family get-together is like being at a comedy revue, only with Jerry, Roger and Teri, it's all natural.

The war came, bringing with it an end to my prosperous days at the Buick dealership. Cars weren't available to sell, and cutbacks were made. I picked up some local welding jobs and managed to survive until I finally got hired at Curtiss-Wright, an aircraft components manufacturer in Caldwell, NJ, where I made aircraft propellers. Teri and I were so short of money we had to pawn our jewelry and barter for food. The personnel director at Curtiss-Wright acted as if he had been looking for me all his life. They were especially impressed that I had apprenticed at GMI. I was hired as an atomic-hydrogen welder, even though I didn't know beans about it. Following my father's earlier advice, I intimated that I knew more than I did. As in my earlier job at GMI, I kept my mouth shut and learned on the job, constantly trying to improve the method and quality of the process. Again, my inventiveness was useful.

There were some 200 welders doing the same process I was doing. But I found a way to weld the propeller sections, using an unusual technique. The system I used allowed me to do a propeller in three-

quarters of an hour, instead of the usual two hours, and with virtually no scrap. I was soon assigned to teach others my technique. Eventually, I was assigned to the plant's quality control board, where I stayed to the war's end, seeking better ways to fabricate aircraft parts.

We never did get Teri's jewelry out of hock; but on the brighter side, after my experiences at Curtiss-Wright, we were never again out of money. That experience with wartime prosperity was my first stroke of good luck with money. The luck has followed me ever since, enhanced by my good fortune in investing.

How did this luck work?

My experience with Kaiser-Fraser stock is an example. The purchase was my first stock investment. I bought I, for one thing, because I was working for a Kaiser-Fraser dealer on the east coast shortly after the war ended. The dealer said everyone was optimistic about the new firm and its products and that I should give it a try. So I invested several thousand dollars.

It wasn't long until I decided to take a leave of absence from Kaiser-Fraser and go back home to Canada for a visit. The move ended up making a significant impact on my life - financially and professionally. On the way to Canada I stopped at GMI. A department head I knew there wanted to give me a job. The school had previously offered me a job, but at a salary that was unacceptably low. The school upped its offer by quite a bit this time, enough to influence me to consider it seriously. I told them I would think about it and give them my decision when I came back from Canada.

I spent the summer in the Northwest part of Manitoba, far from normal contacts with civilization, including the stock market. While I was out of touch with the financial news, my Kaiser-Fraser stock had zoomed. I had bought it at $4 a share. When I finally came out of the Canadian wilderness, it had reached $25 a share. At that point, I sold. If I hadn't been in Canada, I would probably have sold much sooner. On the way back east, I stopped in Flint and told GMI I would accept the job offer. Then I went back to Kaiser Fraser and gave them my resignation. My pockets were full of my stock winnings and I had a new job lined up.

Chapter 2
Thinking Like An Inventor

A 25-cent bet with a brilliant but skeptical engineer was one of the best investments I ever made. That quarter has earned me millions of

dollars.

I remember the experience; it reminds me that creative thinking is a never-ending gamble, but one that can pay off if an inventor is willing to risk a few things, including his ego, in pursuit of ideas. It's hard to teach such thinking. In fact, there have been times when I have wondered if formal education actually interferes with the process of having creative thoughts and the willingness to do something with them. Education may teach too many reasons why certain things won't work.

I'm not saying college isn't important. It is, especially in a highly technical world. College teaches what has gone before. It teaches valuable theories that help solve complex problems. But formal academic training, especially in engineering, may also teach potentially innovative people to discard an idea before giving it a good hard try when it doesn't fit a preconceived theory. Formal education doesn't always teach creative thinking. And creative thinking - the process inventors use to capture ideas and turn them into useful products - is what this book is about.

I haven't had much formal engineering training. Instead, I think through technical problems, using ideas that come into my head. I try to visualize possible solutions until I come up with one that I think will do the job. Then I test the vision in the real world. That's the thinking that turned a quarter bet into millions of dollars. Here's what happened.

Tom Parrish, the engineer I made the bet with, had an excellent college education. As a designer he couldn't be beat. But more than once he would listen to one of my inventive ideas and bet that it couldn't be done. Tom was an executive who had risen through the ranks at GM to a very responsible job in automation before he joined our firm.

Tom and I would often brainstorm ideas, and now and then we would bet a quarter on their outcome. One day we were examining ways to cut metal to a depth below the gullet on a hole saw. The gullet is the valley between the teeth on a saw or drill. I reasoned that cutting beyond the gullet with a hole saw could be fast and smooth; but the shape of the tools at the time could cause it to clog with chips. This was one of the reasons why it hadn't been done successfully before. But I had a vision of cutting edge geometry that was new and untested. My idea was to put a circumferential radial step on the cutting edge of the saw tooth, reasoning that if the width of the chip was equal to the width of the cutting edge, half the width of the cutting edge would generate half as much width of chip. That

would produce two small chips that would be easily ejected from the hole.

Tom said that wouldn't work; a step-shaped chip would be produced that would still clog the tool. We put down our quarters and I went to work. I made a crude prototype cutter with my stepped cutting edge. The tool cut smoothly through a piece of heavy-gauge metal. I won my bet. More importantly, I was so inspired with the results that I continued studying such cutting edge geometry. That original idea eventually contributed to the invention of the Rotabroach, a hole-cutting concept that has help me earn financial success over the past 12 years and looks as if it will go on earning large amounts in the future.

Another example of this type of positive and creative thinking was a patentable improvement to the Rotabroach cutter. I believed its cutting potential was far greater than the current results showed. In dreaming about how to improve the tool, I imagined the cutter having margins on its flutes. To everyone's knowledge, no other fluted annular cutter had ever had a margin. Every good twist drill has them, but the margins got larger as the drill size increased. I proposed all margins on the Rotabroach should stay the same, regardless of drill size. No on said it wasn't worth a try, but no one else had thought of it. The results of the margins on the Rotabroach were unbelievable. In some instances, the life of the cutter was tripled, and in every instance we saw better hole quality and held closer hole sizes.

Everyone I showed that cutter to said it was ridiculous for me to expect to get a patent on it. I felt sure I could and had my attorneys apply for one. Part of the criteria for a patent is that a tool be functionally unique. Having margins on the cutter made it different, and having all the margins the same size is even more unusual. With twist drills, the margins vary with the diameter. The results of putting margins on a Rotabroach are not obvious to someone skilled in the art, and that also constitutes an invention. Lastly, and most important, the results of margins were so astounding that they were nearly unbelievable. None of the engineers I showed it to thought it was a patentable idea. I even talked to engineers at our licensee manufacturing operation in England. They were positive I wouldn't get a patent. They said maybe I would get one in the U.S., but positively not in England. They were all wrong because the patent was issued here and in every other major country in the world.

The lesson from my experience in this instance is that inventors can't afford to be pessimistic. They can't be deterred by well-doers'

negative remarks. By the pursuit of my idea I gained invaluable additional patent insurance for the Rotabroach. This is what competitive leadership is all about. The 17 additional years of protection meant millions more dollars earned from my idea.

I would like to not at this point that age has little to do with inventing. I made my first real invention while I was in my early teens. I am now in my 70's and I have just invented an improvement on my Rotabroach cutter, which has given me my most lucrative patent. Along with other advantages, the new device cuts twice as fast with 25 percent less horsepower than the original concept. In addition I just invented the new Z-Max end mill with earning power at least as great as the Rotabroach. The Z-Max has the capability of cutting vertically and horizontally at unprecedented rates of speed and little wear and tear on the tool.

There's an important lesson, I think, in the experiences I have just cited. It isn't necessarily superior technical knowledge that produces the pace-setting ability to compete in the new global economic arena. Technology, like a particular type of drill, is a means to an end, not an end in itself. Granted, there are some fields that require a significant knowledge base. Electronics and chemistry are two. But I work in mechanics, where things tend to be a bit more visible than electrons and molecules. But regardless of the discipline, the need is the same - seeing the world and its objects in previously unimagined ways. America's real goal in the new competitive environment should be nothing less than competitive leadership, just as my real goal in inventing the Rotabroach was making superior holes, not just coming up with an improved twist drill. I was open to new ways of doing the job. It's new ideas that will do the job in today's tough post-war world economy. These must be ideas systematically encouraged and nurtured by business leaders and welcomed with respect in the nation's plants and offices. Lack of willingness to welcome and nurture ideas is my personal pet peeve.

An example of the needed freewheeling creativity was an idea of mine that was inspired years ago by some cloth adhesive I saw in the five-and-dime store. The idea led to one of my first inventions, the solder tension plate, an idea that produced several patents and earned me quite a few dollars.

Years ago, I was already a strong advocate of stretching bent automobile metal into its proper shape instead of pounding on it in the traditional manner. The solder tension plates I invented were used in this stretching process. I had the idea of soldering a standard hydraulic stretching tool into hard-to-reach metal surfaces. Engineers

at GMI said it wouldn't work because the solder wouldn't hold. I was confident the idea would work, because of what I had seen at a dime store.

There was a product there called "Magic Thread", an adhesive used to bond pieces of canvas or cloth together. When the two pieces of cloth were put together on their flat surfaces they couldn't be pulled apart. But they could be peeled apart. If the adhesive would work on cloth, I reasoned, surely the right kind of metal adhesive, such as solder, would hold the components of a metal stretching machine in place.

To test my idea, I put a couple of square inches of solder joint on two pieces of automotive sheet metal, attached a hydraulic jack to them and tried to pull the joint apart. The joint wouldn't budge, even when I put on enough pressure to tear the metal. I knew I had something. Learning was important from that point on. I had to learn something about soldering. I learned I couldn't just solder the flat sheets of metal together. I had to put down a glob of solder, heat the top plate with a torch, then push the pieces together. Finally, I had a to pour water on them. All that was fine-tuning, though. The important thing was that I gave my idea a try, even after well-informed engineers said it couldn't be done.

I ended up getting a patent on my method of soldering and the stretching tools I invented to accompany the technique. The point here is that keeping an open mind means several things. It not only means being receptive to new ideas. It also means expanding those ideas into new and unanticipated applications. Methods are as patentable as tools. They key to all this is market awareness. This, combined with a creative mind and receptivity to the new and untried, is a winning combination in the inventing business. Often, it isn't what the inventor thinks about, but how he thinks about it, that makes the difference. My experiences with hole drilling illustrate this concept.

I've been thinking about the concept of holes in objects for most of the last 30 years. That's the important thing. I thought about holes in things, not about a particular way to make them. I concentrated on the outcome - an accurate, cost-effective hole-rather than a particular device for doing the job. That kept me from getting trapped, for example, in the pursuit of a better twist drill. There are limits to the potential for improving the speed and accuracy of a device that has to cut and gouge out all the metal in a hole. It could be speeded up. But in the end, the drill is still fighting all that metal, a process that takes extra time and generates lots of damaging heat along the way.

The technology in design and quality of twist drills is excellent. It's the concept that was wrong for countless applications.

Thinking about the final objective eventually turned me toward the idea of improving the old and relatively unimproved concept of the hole saw. I'd guess that the hole saw is one of man's oldest forms of technology. It wouldn't surprise me to learn that archaeologists have dug up a cup-like device with sharpened or serrated edges that ancient man used to saw holes out of wood, leather or animal hide or other material. I know there are many 19th-century patent applications for variations on the hole saw.

But hole saws, to this day, work well only under limited conditions and with thin metal. My approach was to rethink the job not the tool. I didn't invent the Rotabroach as a new kind of hole saw. I sought the most efficient and accurate way to make holes in hard-to-cut materials, without being tied down to any one method. I wouldn't have succeeded by trying to improve hole saw technology, or by trying to invent the world's best twist drill. These tools have fundamental limitations that would have stopped me from achieving my original goal - fast, accurate holes. Instead. I invented an entirely new hole cutting system, using the hole-saw concept as my starting point.

American industry has a problem in this regard, even though many business leaders may not think so. Too many businesses seem intent on improving materials and processes in which they already have a vested interest. Their best creativity is devoted to defense of what has gone before. This leaves drill makers, for example, mistakenly thinking they are in the drill business. Wrong. They are in the hole business. A particular style of drill is only the means. Such narrow thinking can kill many good ideas and new market opportunities before they have a chance to grow.

Systems are needed to open these minds. The world has a great appetite for new ideas and inventions and is willing to pay big amounts for them. Some ideas are instantly successful, as with the Cabbage Patch dolls or the board game Trivial Pursuit. These ideas became marketable products that earned their companies and inventors breath-taking sums. Other novel ideas, like my cutting edge geometry for a drilling tool, earn millions of dollars, but in much less spectacular and public ways.

Through it all, inventors have to be sure they remember their original objectives. They can't let themselves get mired down in trying to improve the wrong thing. They have to start by looking at the job to be done, not only the instrument to do it with. The

instruments can even be invented later.

All this takes lots of concentration. Developing the capacity for such concentration, over sustained periods, isn't always easy. I borrowed a thinking technique from my mother. Her example of taking long trips in her car influenced me to appreciate the benefits of highway solitude.

To do anything with their creative inclinations, inventors need time to think creative thoughts. Time for quiet contemplation can't be a luxury for them. Instead, it's a basic tool of the successful inventor and must be treated accordingly. Even in today's busy world, there are places where inventors and would-be inventors can have a quiet place to think. But sometimes they have to be creative just to find it.

I do a lot of highway thinking. I once had to drive several hundred miles every day to demonstrate a product. I was struggling with an inventing problem at the time. I thought the long drive would help me come up with a solution. For many hours I'd have nothing to do but think. I was right. The quiet and time did the trick. I came up with the creative answer and I've been a serious highway thinker ever since.

There are other good thinking places. One of my favorites is a hunting tree stand. I hunt deer with a bow and arrow each year. Anyone who's done this knows staying quiet and unseen is most of the challenge. I've had five or six hunting stands built in trees on my wooded property in Northern Michigan. Some of my best inventing ideas have come during two, three, or four-hour stints high in a tree, looking out over the quiet forest and waiting for a deer to pass below. Cruise ships are also good thinking places. I've tackled some of my hardest Rotabroach geometry problems while sailing from port to port.

The adage "necessity is the mother of invention" has applied to me more than a few times. The first time I can recall using it was the episode where I got my pony home by having it follow a loaf of fresh bread. My latest application was in development of a new type of bow. For quite a few years my sons had tried to persuade me to take up bow hunting. But I couldn't pull back a bow with a draw any stronger than 35 pounds. To hunt effectively, I had been told the minimum pull on a bow should be 50 pounds, with 60 pounds as ideal. There is too much chance of just wounding a deer when using a bow with only a 35-pound draw.

The challenge of this problem and my desire to hunt deer with the boys provided the impetus to invent a solution. One day in Northern Michigan at our lodge, I began concentrating on a new type bow.

The cross bow would have worked fine, but it is illegal because it is mechanically drawn, held and released. A few hours of concentration gave me the concept of a new bow. It would be hand and foot drawn, hand held and hand released so it would b legal and still enable me to pull back a bow with a 65-pound draw. I built one that didn't work too well, so I built another and it worked great.

Since inventing this bow five years ago, I've bagged at least one deer a year. I brag to my boys that I'm the only Hougen in this family that has killed every deer quickly, and has never just wounded one. This invention has given me the most enjoyment of all, and has also provided me with a very low-fat meat. Having had several heart attacks, a cardiac arrest and a stroke, I don't cheat on my diet. I can eat venison in moderation and not consider it cheating.

Neither heart problems nor age have had an adverse affect on my inventiveness. Even death hasn't stopped me. My heart stopped when I had my cardiac arrest and I was actually considered dead, but I recovered and I am here today, still inventing. Stubbornness is another requisite to inventing; anybody who is too stubborn to die is sure to be inventive.

I've often driven by fire stations and been jealous at seeing those guys sitting there with what seemed like nothing to do but think. I've never been a firefighter, and I'm sure there are lots of things to do around a fire station while waiting for the alarm to go off. So I suspect my impression of the think time available to the average firefighter is exaggerated. Nevertheless, I'm also sure there are gaps in a work shift that could be filled with the kind of creative thinking that is essential to successful inventing.

The simple things are usually the best. In the pursuit of thinking time, long walks have great potential. Walking is an excellent aerobic exercise and it's one of the best ways to concentrate on inventive ideas. I walk from three to five miles a day.

People with jobs that give them lots of time to think might consider becoming inventors. In my opinion, time and willingness to think are the most important ingredients for the inventing profession. Most people are too busy earning a living to have time to think or be creative. I was like that while I was on the faculty at GMI. I was too busy teaching to have time to create. That's why I looked forward to being on those long motor trips. I would have nothing to do but stay on my side of the road and think about creative solutions to my inventing problems. Later at GMI, my schedule wasn't so hectic and my inventing career thrived. Soon I was paying more in taxes on money earned from my inventions than I was making in salary at

school. At that point, I decided to become a full-time professional entrepreneurial inventor. Inventors usually find that ideas breed more ideas, and so it has gone for me.

I'm not saying I sometimes don't get discouraged, because I do. In fact, after each invention, if I don't get an inspiration for a new one, I fear I've run out of ideas. I can remember thinking like this 40 inventions ago but have learned patience, concentration and awareness will allow a first invention and a 100th one.

Chapter 3
Reading the Market

Just by putting something new on the market, an inventor disrupts the status quo, if only in some small way. Beginning inventors can't assure that those disruptions will always be warmly welcomed by potential customers, regardless of how useful the invention may be. There may be real, if possibly unfair, economic forces in the potential market that will reject even the most seemingly valuable creation. And there is often an unwillingness to change. Let me illustrate with the experience of an inventor friend of mine and some of the experiences I had over the years trying to develop a market for my Rotabroach technology.

First my friend's ordeal with the status quo. Benno Swarts was an inventor in Cleveland. I was coming home from a trip to New York one day years ago. My plane had a layover in Cleveland so I gave Benno a call and asked him if he could meet me at the airport. During the layover, he told me about a spot-chrome repair process he had invented.

With a few chemicals and some relatively simple equipment, a body repairman could easily repair scratches and gouges in bumpers or other chrome parts of cars and trucks. I got so involved in what my friend was telling me that I forgot to catch my plane.

So I stayed the night and end up going into business with Benno through the development and early marketing phases of his invention. The more he worked on his process, the more useful it began to appear. The process was extremely effective. With our kit, a chrome defect could be covered and blended so it wouldn't show a bit. And best of all, the whole process only cost about $35. With it a body shop man could repair a $200 bumper for less cost to customers or insurance companies.

That's where we ran into trouble, though. The repair shops, both

independent and in dealerships, rejected the invention because it cut into their potential business. They wanted to sell new bumpers at $200 or more each, plus the labor cost to install them. We had invested about $100,000 before this basic reality emerged.

We never did get the process onto the market in a substantial way. The repair shop's investment in chemical solutions and equipment would be minimal. The process took only minor training. But it was simply more lucrative for the repair industry to do the work the old way. Economic realities wouldn't let the invention get off the ground. The lesson I learned was this: With the market resisting the product, forget it. When something is invented, especially for other business people to use, there must be money in it for everyone involved.

How true was that lesson? One indicator was what eventually happened to the spot-chroming process. A market-wise major chemical company was interested in our product. In fact, we eventually sold it to the company at a profit on our investment. I've been told they spent an additional $1 million on the invention, and it still was a failure in the market place, further proof that market forces must be considered in the inventing business.

My own Rotabroach has run into similar if not as destructive problems over the years. The difference is that I adapted to economic realities as I saw them, avoided a market that wasn't ready for my idea, and instead applied it in a different field. The results, as will be shown, were several valuable patents, increased safety for workers, and a significantly improved technology for drilling heavy steel. I stayed away from one market, that wasn't ready for my invention, and used the same technology to enter a market where it would be well received.

Here's how I positioned my idea in the market. As a body repairman, I often had need to remove sections of sheet metal that had been spot welded together. Separating these sheets in the traditional way, with an impact air chisel, caused additional parts of the auto body to be damaged. I spent a lot of time studying the problem of separating damaged panels held together with these small but abundant welds. I finally hit on the idea of cutting them out with a small hole-saw type cutter. As I said earlier, hole saws in many instances had been notoriously ineffective devices. And back in the 1950's, when I launched my campaign against the spot welds, they were even less reliable. So it became obvious that I would have to improve existing technology, and that's what I did.

I simply redesigned the cutting geometry of the typical hole saw and

ended up with a very effective cutting tool rather than an ineffective cutting saw. And this was without any of the stepped cutting surfaces that I would develop years later. All I wanted was a spot-weld cutter, and the one I invented did the job exceptionally well. The market was right and the little hole cutter sold well; I have sold millions and millions of them over the years. The patents have long since expired but we are still the largest manufacturer of these tools in the world. We hold this position because of manufacturing technology and superior quality and service.

It seemed logical to assume that such success with hole cutting for body shops could easily be shifted to a different market, in this case industrial manufacturing. But it wasn't quite that simple when I invented the first Rotabroach Cutter, using variations on my earlier hole-cutting technology. I upgraded the cutters and with the improved product, tried to get into the industrial production market. This time, though, the market was unwilling to consider a change. Market conditions weren't quite right so I had to adjust my thinking - I was the one who had to change.

The Rotabroach has different requirements than a standard twist drill. In some cases, there are considerable costs to the industrial customer in adapting the Rotabroach technology to the many potential plant applications. My idea was to sell rights to my invention to a twist drill company. That's where I ran into the kind of inflexible and limited thinking I mentioned earlier. I contacted some of the large twist drill companies to see if they would be interested in buying the exclusive rights to my idea and pay me a royalty. I approached a couple of large tool companies and they weren't the slightest bit interested. They were in the twist drill business, they were making money and they were appalled at the idea of venturing into some new hole-drilling process using cutting technology other than their own. Besides, I have come to believe over the years after winning several patent-infringement battles, that there was also a belief on the part of those companies that they could crush any upstart who cut too deeply into their markets.

These companies had thousands of people on their payrolls and engineers coming out of their ears, all devoted to designing better twist drills. Here I was, only a body repairman, and I was entering their field with a drilling tool technology they hadn't dreamed possible. Maybe too, the people in these companies were just too close to their products. As I said earlier, they had forgotten their real business - helping their customers make the best, most cost-effective holes.

People can become so close to their work they have difficulty comprehending a new and different concept. Today, many companies are embattled the same way the automotive business is, with competition from abroad, and better design concepts threatening their foundations. American industry cannot afford to be complacent. We at Hougen do not intend to fall into this trap. Our patents and patents pending could give us competitive security for years to come. But we try to operate as if they were to expire next month.

There were, and are, many difficulties in trying to convince our industrial customers of this complacency problem, much less persuading them to change. They perceive economic gain in the short run to be more desirable than investing in technology that would pay off substantially in the long run through greater speed accuracy and ultimately customer satisfaction.

In addition, and this is significant to the aspiring inventor, decision makers in these companies didn't even know that they had a problem with their drilling technology. After all, they reasoned, they were making adequate profits with their existing equipment. Why invest in something new? There wasn't enough competition to warrant the added capital investment. I attempted to tell them "You don't realize you have a problem, but you do because with my tool you could do the holes much efficiently and with better quality than you do now." Such realizations convinced me I would have to prove my theories in some other field before I could make progress in the heavy industrial market. I was down but not out. Meanwhile, I knew time would be on my side. My kind of innovative, entrepreneurial efforts were being duplicated thousands of times over in the changing global economy. I knew it would only be a matter of time before all this technological advancement caught up with American industry, which was living off its limited post-war advantages. Increased worldwide competition would bring greater interest in doing everything on the American factory floor faster and more accurately. At that time my Rotabroach would take on new significance among many industrial leaders. Meanwhile, I had to find a different approach to proving the value of my product.

I decided I would enter a different market for the time being. I would develop a superior magnetic drill that would use the Rotabroach cutter for the fabricating and construction industry. There was plenty of room for improvement there. And there were thousands of smaller companies with management closer to the plant floor. My magnetic drill would prove the superiority of the Rotabroach. It also would financially benefit the companies making the investment and would

be popular with the workers, since it would make their jobs easier and safer.

The magnetic drill is an important device in the heavy construction industry. Most holes in bridge or building girders are put in while the metal is on the ground, where the process is considerably cheaper and safer. But such predrilled holes don't always line up when the girders are hoisted into position. When that happens, construction workers have to climb into the superstructure and drill new holes.

This is risky business. The holes tend to be big ones, and so are the drilling machines that make them. Handling such machines high above the ground or water takes courage and skill. The market demands speed, safety, accuracy and lightweight.

So that became my objective - designing a new kind of magnetic drill that would use the superior cutting characteristics of the Rotabroach, be safe and yet be within the budget of the smaller construction companies.

A completely fresh look at the present magnetic drill had to be made. They say, and quite accurately, "invention breeds invention." In order to reach my objective, I had to come up with three new inventions. To cut holes with a Rotabroach presented several minor problems, such as picking up the exact location point to begin the cut, ejecting the slug (the unused center portion of the hole), and getting lubricant to the center of the tool. Developing the concept to solve these problems and building a prototype cutter took about six months.

I also wanted to improve my cutting geometry. This was the subject of much of my thought during those hours behind the steering wheel or sitting in hunting tree stands. I had to imagine the interaction of the cutting teeth with the metal under high-speed conditions, first with existing tooth designs and then with various designs that popped into my mind. I'd ask myself over and over, "what if this and what if that?" Then I would envision what the cutting process would look like with each type of geometry. I eventually came up with several possibilities. From these I fashioned prototypes that I tested under working conditions.

The Rotabroach required less power for its cutting action than an equivalent twist drill. This meant I could use less torque, and therefore less power in a magnetic drill. All this would allow the drill to be much lighter than those already on the market. So instead of a 100-pound magnetic drill, the result was a 30-pound drill, one that was considerably easier to carry up to the girders and to use once the worker got to the drilling site.

The most popular hole for construction is thirteen-sixteenths of an

inch. This hole takes a three-quarter-inch rivet. So I developed a tool for this size and it sold well. Then there was a strong demand for seven eighths-inch holes, and then half-inch holes. I had to keep rethinking my product if I wanted to get more and more share of the market for magnetic drills. So I redesigned it for these other hole sizes.

When I went to a 2-inch hole (which had never been cut before with a magnetic drill), I encountered a complete new set of problems. Such a large hole requires a cutting machine that develops a lot of torque. That increased the dangers of drill seizure, and possible injury to the operator. Moreover, the motor I wanted to use had 150-foot/pounds of torque. Nobody could hold back that much force if the tool grabbed the metal being cut. I don't care how big and strong an operator is, a seized drill with that kind of power could easily knock the worker off a bridge or building girder. I tested a drill with what I thought was a grab-proof tool and once or twice it grabbed and skidded away. I wasn't hurt but I realized I had to improve the safety aspects of my machine. At that time, we were about to go into production on the larger drill. But I told my production and engineering staff to hold up. There was more inventing to do, this time on safety.

I invented a device that would drive a point into the I-beam. This would prevent the machine from spinning if it grabbed. The point made only a small prick mark, hardly of concern on a bridge or building superstructure. For the magnetic drill to spin with this safety feature, it would have to drag the point through the metal. Under most circumstances, the point would hold the tool in place. But then, I thought, if you're betting your life on it, more safety was needed. What if the beam was slightly irregular or warped and the point didn't grab? So I came up with the idea of a toggle switch. I would put it in the middle of the magnetic plate where it would make contact with the metal. Any movement upward or sideways and the drill would immediately shut off.

So now I had it. The spike would hold under most conditions. If it failed, the toggle switch was there for a backup.

This story illustrates how the market must be "sized up," and the product modified to hit the target. A shift into another market in response to economic realities led to improvement in magnetic drill technology, and to several new and ultimately very lucrative inventions for me. Within a short period of time, our sale went from nothing to selling more magnetic drills than all the other companies combined, including such industry leaders as Black & Decker,

Milwaukee and others.
I had set out to show how effective my annular cutting technology would be. I had to do it in the construction industry because I wasn't being well received in what I considered the most lucrative market - heavy manufacturing of automobiles, farm implements, heavy construction machinery and aircraft. In the course of developing our magnetic drill, I invented two safety features along with improvements in the Rotabroach cutting geometry. To do this, it was necessary to read and manage the market and to keep an open and creative mind when developing the product.

Chapter 4
Inventing as a Business

I think there's a drive in most Americans to become famous. One way is to see the products of their ideas for sale in the great competitive marketplace. I share that drive and the satisfaction of knowing people will pay good money for something that derived from my thoughts. But I also like to invent and I want to keep doing it. Long ago, it became clear what this would take.
I would have to manage my ideas the way I would manage a business. I would need a fair return on investment for my innovations. This would require a system that generated cash rewards for myself and the people close to me - a system based on methods and tools that would assure a constant flow of new proprietary products.
In my business approach, the satisfaction of seeing one of my inventions for sale comes later. I like to pass a body shop and know that my tools are being used there. I like knowing a plant is using my tools to put a hole in a car part or other product, or see a bridge and know that the builders put thousands of holes in the girders with my inventions. But it's also satisfying for me to know that these inventions are protected and that me and the people close to me will continue to receive the rewards from producing and selling them. This approach is enhanced by the satisfaction of knowing that I have also made a contribution to society and to the world economy. If an idea leads to long-term production, the inventor can enjoy knowing that he helped provide new jobs that wouldn't exist otherwise. In addition, if an inventor is conscientious about his products, he'll assure that he helped contribute to the safety of the nation's working men and women.
I know in my magnetic drills, for example, that the safety of the user

has been a constant design concern. I have devoted just as much creative energy to the engineering of safety features on my products as I have on the products themselves.

There's also intellectual satisfaction in inventing, especially in overcoming the inevitable tradeoffs that come with changes to a product or a production process. As anyone who has done creative work knows, for every gain in one area, there is a risk of losing somewhere else. The trick is to develop a way around these tradeoffs so the inventor ends up with a superior product. In drilling metal, for example, higher speed will generate more heat, so cooling must be considered. Tempering can help a tool keep its edge, but I can add time and cost to the production process. New cutting geometry may provide better cutting qualities, but the angle may also generate more heat.

So in the last analysis, nothing in the world is free, even ideas. Inventors, like everyone else, have to give up something to gain something else. It's a never-ending balancing act. Success lies in making the proper decisions throughout the process, so you end up with a product that is desirable, producible and profitable. To be successful in business, what is gained has to exceed what is lost. Good judgment is one of the inventor's most important business talents. Getting an idea patented and marketed is expensive and risky, so it's important to come up with the bet possible ideas in the first place. I have developed a rule of thumb in the pursuit of quality ideas: Invent in your field. There's always the temptation to ignore one's own area of expertise as being too mundane and boring. That should be avoided.

I started in body work and throughout my career I've invented tools to do this type of work better. I've gradually moved into other product lines, but always ones related to my own are of expertise. My companies are now in the automotive aftermarket, the metal fabricating market and the industrial fabrication market. These are all related in many ways to my original specialty of metal shaping, cutting and drilling.

This approach has always made sense to me. Why should an inventor try to crack a foreign and potentially confusing field when he or she already has a sound grasp of a specialty? Inventors are more apt to be successful dealing with familiar territory. A body man deals with formed sheet metal panels. He knows how they behave under compression and impact. He knows how they behave under compression and impact. I know how this field works and I have prospered init.

Few "would-be" inventors seem to grasp this important fact. People often ask me to evaluate the potential value of their inventions. I don't think I've ever had anyone come to me with an invention that was in an area he really knew. Carpenters don't come to me with improved carpenter tools. They come to me with ideas for cars or garden hoses or something. Doctors don't come to me with ideas for improved medical tools. More likely, they show up with something to do with golf. Needless to say, these ideas seldom succeed.

I taught myself this lesson a few times. For example, there was my painter's palette. I used to do a little dabbling in oil painting. I hated the mess of cleaning up after every session at the easel. So I screwed my tubes of paint to the underside of a box lid. The lid served as the palette. When I wanted a particular color, I'd squeeze the paint through a small hole. At the end of the day, I'd just wipe off the top of the palette, then stick plugs in the paint tubes so they wouldn't dry over. I ran a patent search on that idea and found that someone had already thought up something like it. More significant, though, the paint distribution system was in a field foreign to me. These were reasons enough for me to avoid pursuing the invention.

Another example of a good idea, but one I probably won't patent or attempt to market, is the customized hunting bow I mentioned earlier. I think the basic idea of that invention is solid, but it's out of my field of business. I don't have a distribution system in the sporting goods field. Then there would be the need to figure costs in an unfamiliar area. Going into production could cost $500,000 or more. Then, if the product didn't sell, how would such an investment pay off? I did show my idea to several people, and one individual asked to have a market study made. If that goes well he might have a patent search done, then endeavor to market the shooting device.

Some inventions with strong market potential don't need patents; they can be moneymakers without such protection. I learned this with an invention I called the "Twist Lever Pick." This device was simply too easily copied to be worth patenting. It was a rod with several bends in it for use in pushing out dents in metal body panels. Other manufacturers could put in slightly different bends and end up with a product that would do the same job as my tool. So I just started making and selling the Twist Lever Pick, made as much money as I could from it, and then left it to the competition.

Another unpatented device of mine, one I earned hundreds of thousands of dollars from, was a frame-straightening machine. Prior to my introduction of these machines, very few damaged auto frames were repaired with portable devices. Usually, the car had to be

driven or towed onto large and expensive stationary machines, which might take up an entire bay of a repair shop. The straightening devices I designed were unique in their application of straightening forces. They were lightweight, and easily maneuvered on casters. When demonstrated properly, they would often end up sold to a body shop.

The frame straighteners were the type of equipment that didn't wear out, so once a body shop bought one, it was unlikely to need another. After four or five years, there were many limitations and strong competition, so profit per sale fell drastically. Also, the market was pretty well flooded, so I opted to divert my energies to designing perishable cutting tools. What I did with the straightening machines was hit the market hard when the method was new, invested the profits wisely, then moved on to something with much greater sustained sales potential.

The lesson here was: Don't have false pride and try to do the impossible by hanging on to a sinking ship. Take pride in the fact that you've made a large contribution in changing an industry, and also have made a lot of money in the process.

Another way to make inventing a successful business, or any other business, for that matter, is to manage growth. My recommendation is simply this: Grow slowly. Beginning inventors will be tempted to borrow working capital, sometimes by sharing the potential income from ideas with outside backers. This should be avoided whenever possible. New inventors should operate on a small scale at first.

The inventor has a responsibility to conduct his business prudently. What kills off small business, as often as not, is poor management, usually revolving around ego. The scenario goes something like this: The inventor has a salable idea. He borrows capital, opens a shop and starts making and selling his product. The profits come in and he decides to show off his new prosperity to the world, even if this display doesn't contribute substantially to the business.

That's where the trouble usually begins. New and expensive office equipment and furniture is ordered, and perhaps plans are drawn up for a new plant, even if the old one is not being used to capacity. Prestige takes precedent over demonstrated economic need. With such growth comes more and more distance by the founder from the workforce. Where the innovator used to be on the same floor with the people who did the hands-on work, now he's closeted in a plush office, where he's making "high-level" decisions. From this exalted position, he becomes more and more out of touch with the product and the workforce. Fresh ideas don't flow as freely, or they take

longer and longer to be implemented. That's an example of a serious business mistake and one to be avoided. I continued working as an instructor at GMI for years while I was developing products. As I said earlier, I didn't leave the school to become a full-time inventor and businessman until the taxes I was paying on money earned from my inventions exceeded my income as a teacher. And even then, I kept my expenses to a bare minimum. I hired only two employees and worked out of my basement for years, while paying others to do my manufacturing. Then, when I had enough capital, I invested in a building and machines, hired more workers and began doing my own manufacturing. By going slowly, I learned to make wise business decisions.

Then there are the companies, big and small, whose leaders don't believe they have to change. They don't want to change the processes that worked so well in the past. They get by with the same technologies and the same number of people. There's little or no growth. At my shop, we have the latest in technology and we update it constantly. Everything is on computers - the inventory, manufacturing, etc. Even our housekeeping is carefully managed.

I personally have known many firms guilty of maintaining the status quo in the face of needed change. These firms are often unsuccessful on a long-term basis.

I feel fortunate that I've been able to keep my ability to recognize the need for change even if there is risk involved. Many people my age don't even think about computers. They don't want any part of keeping up with new processes or new ideas. Hougen Manufacturing acquired some of the first computers available. We had to write our own programs, at costs in the hundreds and even in the thousands of dollars. And as fast as we modernized our computer systems, new ones would come out that were even better and we would have to scrap the old systems and start over. All that replacing seemed awfully expensive and time consuming as we were going through it. But the result has been that our products remain state-of-the-art. Our quality is the highest in the industry and our customers are loyal. Moreover, throughout the never-ending modernization process, we have formed what I would consider good work habits for these highly competitive times. Managed change has become a way of life at Hougen Manufacturing Company, Inc. We see today's success as temporary - something to be protected by implementing well-planned change for tomorrow.

Besides investing in the best and latest technology, a good business must hire and invest in good people.

We don't just hire bodies. Instead we look for employees with the hope they have the capability of making worthwhile long and short-term contributions to the business. I consider it part of my responsibilities as Chief Executive Officer to help find the best, most talented people and provide them with the freedom and support to do their best work.

I give my managers and directors the freedom to innovate and give them enough control of their departments to maintain a strong self-image and maximize their individual contributions to the company. At my company, I don't continually guide and direct the various departmental functions. Engineering, sales and marketing, finance and the productions department staffs are in control and have freedom to do what they think best, and they get results. I intervene only if there may be a serious technical problem or an unjustifiable drain on profits. Our controller has developed a strong pension plan and benefit system for our employees. One of my plant managers had an idea for a new product. By giving him the necessary freedom, the idea became a prototype and finally a finished product. We were able to obtain a patent and now all our employees can benefit from that one idea for many years to come.

Most of my supervisors have come up through the ranks. Many were cooperative students from local high schools who worked with us during their school years and then stayed after they graduated. I guess the average working age in the shop is the late 20's. Having such a young workforce, with new young people coming in regularly, ahs paid off because they contribute to the innovative environment in the company.

Training is important too, and is constantly emphasized at Hougen. When we buy a new piece of equipment, we want the operators to know as much as possible about it - so they can use it to its fullest potential. So we send the employees to school for two or three weeks, whatever is needed, before putting them to work with the new equipment. We also send their foremen. Then we combine this with extensive training on the job.

Such training is expensive but it pays off. The operators know what their machines can and can't do. They also learn the maintenance of the machines. This helps avoid costly breakdowns and other delays. Good maintenance keeps the machines running around the clock. We earn our training investment back and then some.

While I strongly favor innovation and acquisition of the latest technology, we are careful about how we go about this. I don't believe in buying equipment just for the sake of adding to our

collection of machinery. We'll run machines at greater intervals before adding to plant space. We've got several millions of dollars worth of machines running now and we've found we can run them fewer hours I the day because they, and the operators, are so efficient. We've also been able to cut down on our number of employees. At the same time, our sales have tripled. Our conclusion: Investment in technology and training is always profitable.

But how do you know when new technology is needed? It's seldom easy to answer this question. For example, there's no reason to tear out a machine because it's two years old. The equipment should be evaluated at least every year, comparing its performance to the new equipment that has become available. If the numbers indicate that replacement is the way to go, then the machine should be replaced. But if the numbers indicate that quality, competitive position and bottom line return will remain up to standard with the old machine, it should continue in operation.

It's hard to know what is the best technology to purchase. We have some automatic lathes that were the latest in technology eight years ago. We've kept close tabs on the metal working field since then and we are convinced that our machines are still very close to state-of-the-art. If we bought new technology now we'd get maybe 5 percent better efficiency, 10 percent at the most, with no major improvement in quality. This wouldn't be worth the added cost. So we haven't replaced the lathes - yet.

The company's values must extend beyond immediate return on investment. If that's the only criteria for deciding whether to invest in new technology, chances are the new technology will be postponed, possibly to the point where the competition gets ahead. Then technology acquisition becomes a race for survival, and that's not a good competitive position to be in.

One way to keep current on the latest technology and what it can do for the business is to attend the machine shows and read the literature. That's where the newest thinking is on display. Then it's important to heed the advise of experts inside the company. We pay our engineers to attend the machine shows, so I owe them an attentive ear when they come back with information on the latest technology.

Even though we commit large amounts of capital to technology acquisition, it pays off in the long run. We've made improvement of products, machinery and manpower a way of life. I think there are potentially valuable lessons for the rest of American business and industry in this approach.

The various aspects of protecting ideas are also of great importance to inventors. I put a kitty aside years ago in case I had to go to court to defend my inventions. Over the years, I have let everybody know that I was willing to stand up for my patents. My patent-defense war chest started with $40,000. Now I have $1 million in the pot, and I'm willing to spend it to protect what I have created. A lone inventor can take on the big boys if he has the money. So it is important to save and invest your early earnings in some form of patent protection. I was fortunate in not having to defend a patent in court for some 30 years. When an inventor has spent thousands of dollars developing a product, he shouldn't have to ask himself if it's worth going to court to defend. Of course it is.

I practice this rule consistently. There are other makers of magnetic drills. I had thought they would come to me with offers to buy rights to use my safety features. But they didn't, so I've kept them unique to Hougen. A lawsuit I am currently pursuing with a major tool making company is for an infringement, because they've copied some of these features. It wouldn't cost but a few percentage points of the price of each magnetic drill to buy the rights fairly. I'm betting $300,000 or more in the belief that I'll win my right to the features. So are my opponents. How much less costly, and safer for workers, it might have been if this hadn't been the case.

The inventor's greatest resource in protecting ideas is the guidance of a good patent attorney. What makes a good patent attorney? He has to be a good lawyer, of course. And then he has to be a good engineer, or at least have good engineering knowledge and instincts. The better the attorney, the less likely the inventor will find himself in court in an infringement case. An inventor needs absolute trust in his patent attorney. The patent attorney will help determine if an invention is even patentable in the first place. If it is, he will be of great value in working through the complex patent-issuing process. Believe me, patent law isn't for amateurs.

In a sense, what the inventor needs is a strong collaborative relationship with his attorney from the very beginning. The inventor plays an important part in the writing of the original claims. He must impart tot the attorney the broadest parameters in which a mechanism, shape or process will work. If he doesn't, competitors may change something in their design slightly and end up with almost as good a product. No one can work out these parameters better than the inventor. Finding them may require that the inventor work with other skilled people for months. The time will be well spent. A patent is not better, in the end, than its original claims.

Once the decision is made to try to patent a method or tools, the inventor must determine if patent requirements are met. Once again, a patent attorney is essential. Either the inventor himself or someone on the attorney's staff, must sort through all relevant existing patents to determine if an idea is in fact new, or at least a significant variation on existing knowledge. My attorney, who specializes in patent work, has associates in Washington who perform these searches for him.
The beginning inventor shouldn't be too concerned about divulging proprietary information about an idea in the course of a patent search. One reason for getting a first-rate patent attorney is that he and his associates can be trusted completely. I've only had one idea that I felt was too sensitive to even subject to a search - and that was one that might have put me out of business if I had even put it on the market myself. The new device would have damaged the strength of a number of my existing patents, because it was only slightly better than previous tools and I felt a good strong patent on it would be almost impossible to get.
Something I learned early on was that the best patents are the ones on both a tool and a method for using it. In the case of the metal straightening clamps, I got a patent on the clamps and on the process for using them. In another case, I developed tools for welding together two flat sections of metal. Regular methods, using a welding torch, would invariably warp the metal sheets out of shape. My technique required shaping the metal into a seam before welding, using tools I invented.
I know very few usable patents that have come from studying earlier failed designs. Some companies look through old patents and try to get inspiration from a tool that was patented years ago and didn't work out because the metallurgy wasn't good enough or the timing was wrong.
My inventions have all been my own conceptions. If I were to advise anyone on developing a new hole-cutting device, I'd advise them not to go into the patent office and look for other people's ideas. It could potentially contaminate a person's thinking. A better approach is to look at the successful tools being used now and them think of tools or methods that will work better. Looking at failures exposes the would-be inventor to needless discouragement.
That doesn't mean an inventor should never look into the history of his field. The experience can be useful, if not actually inspirational. In looking through patent records from the 19th century, I have developed immense respect for American inventors as pioneers, especially those at work during the highly innovative period at the

end of the last century.

Many were brilliant people who had to make do with much less knowledge and technology than we have today. They came out with many of the important concepts, especially in mechanics and metal working, that we're merely improving upon today.

The hole saw is an example of this. As I noted earlier, the hole saw is relatively old technology. A number of improvements were developed in the late 19th century. But my predecessors in this field lacked many of the fundamental resources that I had, even back in the 1930's and 40's, when I was still trying to punch out spot welds on car bodies. I can appreciate this, since I've had to develop a number of my own heat-treating objectives. Most of these weren't available to the 19th century inventors. Digging through the old patents has made me realize how much my work depends on all those people who developed their ideas in the past.

Royalties are an important consideration in the inventing business. Inventors must know when to make a product themselves, and when to turn it over to others to make on a royalty basis. To do this, it is important to know how to get the best possible percentage on a royalty agreement, if that is the chosen production route. An experience I know of can help illustrate this concept.

A neighbor of mine came up with an excellent invention, a unique magnetic door catch of the type commonly seen in homes. In my opinion, he didn't push for nearly enough royalty on his idea. He's made good money on it over the years, but not nearly in keeping with the product's potential. There are millions of doors that have been improved by installation of his catch. Had he been advised properly, I believe he could have been more financially successful.

The lesson here for inventors is significant - don't give your idea away. It's easy to do. Inventors are often victims of their own pride. Their ideas can become the children of their imagination. They make prototypes of the idea and test the prototypes. When these are successful, they want to get the product on the market immediately. So they agree, often much too quickly, to have someone else make the product on a royalty basis. The royalty is often way below the invention's potential. It's nice to have the invention on the market, but it's nicer yet to make money on it. In fact, getting a fair royalty on an idea takes hard, businesslike bargaining. This can sometimes be a prolonged process. There is little room for ego.

In the industries that my inventions serve, I make 7.5 percent royalty or more on every one of my products that's sold. I've been offered as little as one-half of 1 percent. I consistently turn down such

ridiculously low offers. With 7.5 percent I get a good return on my ideas. You have to negotiate up to a figure that makes the royalty valuable, unless there are special circumstances. For example, the product might need lots of additional developmental work, or it might be in a field with fantastic sales potential. Under such circumstances, one-half of 1 percent might be reasonable. In all cases, look for a guaranteed minimum royalty. This requires careful bargaining. Don't be bashful about what you think is fair. Get help or advice from your patent attorney and someone who knows the particular field your invention is in. In Japan, a company I was negotiating with told me the government had a limitation on royalty amounts and could not pay 7.5 percent. I still said no and eventually I got what I was asking. I don't know if the government made an exception or if the negotiators were playing games with me. For a beginning inventor to determine if he is going to make good enough profit on an invention, he has to closely examine market potential.

In the case of my Rotabroach concept, I knew there were enough holes just in manufacturing a car to dictate there would be plenty of market for an efficient drilling device. Millions of cars are manufactured each year. In addition, there are after-market holes to be drilled for options and accessories. At best, a drilling tool will be good for a thousand holes. So it was clear to me, by just doing a bit of simple arithmetic, that there would be plenty of market for my hole-cutting technology.

Then there is the specialty-hole market in thick metals. With the best of tools, manufacturers can cut only one or two holes before a tool must be replaced or resharpened. Some of the new plastics and synthetic materials can wear on a tool as much or more than steel. So this, too, represented a strong potential market.

As an inventor, I've had to get out and sell the products, make my own brochures and plan my own advertising and publicity campaigns. I don't profess to be an expert at this, so I've since hired specialists to do such jobs. The important thing is to see the need for this additional dimension of the inventing process in modern industrial America.

I'm not a salesman per se. But I know that selling is important to the inventor. If someone sent me out to sell life insurance, I'd be a complete flop. But no one can sell a frame machine or a tension plate as well as I can. The best salesman for an invention is the inventor. He has enthusiasm for the product and knows it better than anyone else. After all, he invented it.

Selling has its hazards, as I have learned on more than one occasion.

Once I was at a convention of state insurance adjusters and I forgot how a body-straightening machine of mine worked. There were hundreds of people in front of me. I was going to demonstrate stretching metal. I had to put the device together, and I did it wrong. I forced a pin in incorrectly and therefore it was bent. In front of all these people, I had to take a big sledgehammer and drive the pin out, then put it in right. The audience got quite a laugh out of my struggle. But ultimately the demonstration was a success. I even sold a few machines.

Another sales ploy I used was to haul a car door form body shop to body shop, along with my metal straightening equipment. I bash in the door with a big hammer, then straighten it, all before the eyes of the repairman. I'd get a lot of sales that way.

In many respects, the existing subordinate position of American industry puts considerable responsibility on the nation's innovative thinkers, including independent inventors who want to see their ideas put into the marketplace. It's our responsibility to have more than just good ideas. We also have to find ways to turn those ideas into new, functioning tools and processes. The best way to do that is to convince American business leaders that the new ideas are better. Inventors must find ways for executives with decision-making power to observe the new products and judge their worth. We inventors have to open new doors. We have to sell to people by teaching them the advantages of new ways. That's why I value my years as a teacher at General Motors Institute. I learned to teach others, and now I find myself doing it more and more with business leaders. Having good ideas is the first part of the process. Convincing others to implement the new ideas is second. It adds up to being a successful businessman as well as a good inventor.

Chapter 5
Competition and Quality

I've developed a simple policy in my business ventures; behave like the competition is about to overrun the operation, even if the competition is actually far behind.

That approach is my first line of defense in the constant battle against complacency, a state of mind that is possibly the greatest single source of ruination among businesses. The complacency process works like this: A business overcomes competition and becomes successful. Measured in economic terms, this means it makes sufficient profit. While the leaders in this effort are patting

themselves on the back for their outstanding performance, and often paying themselves fat bonuses for their efforts, the competition is gunning for them. After years of success, the leaders start thinking of market dominance as their God-given right.

They get lazy and protective of the status constantly looking for ways to improve the operation. We now have developed techniques that allow us to use water in the grinding oil, which greatly increases our productivity. Our machines are state of the art. Most are controlled by computers.

Our engineers and technicians are trained to look for new ways to make our products. All I ask is they come back with the numbers that show how the new processes will benefit our business. If the numbers are favorable, we'll buy the machine.

I know our production will continue to increase through such an approach, and I know our quality will improve because we run our operation as if our survival depended on it. That's easy for us to do because we know our survival does depend on quality. Accepting shortcuts in quality or succumbing to the lure of unimpeded production can spell eventual disaster.

Each machine operator in the production process checks every tool we ship carefully. If we start getting scrap at any point, the operator stops production before a real problem is created. When we check it, we usually find it is merely a machine that is out of adjustment. The machine operator is trained to make his own adjustments and to be responsible for producing good parts every time, so he or she is usually the first to spot the problem. The steel we use costs about $4 a pound, compared with about 50 cents a pound for mild steel. So each piece of scrap is worth quite a few dollars. Fortunately, because of training, concerned operators, and the use quo, which is paying off nicely for everyone involved. From the heights of such success, it's hard to see the competition creeping up. Then, often with blinding suddenness business finds itself with outdated technology, complacent leaders, frightened and sometimes disoriented workers, competition approaching from all directions, and no evident plan to handle the situation.

The trick for business leaders is to minimize or completely avoid the habit of celebrating success. Making money should be a source of satisfaction, but also a danger signal that warns of the need to push as hard as ever for innovation and managed change.

I see this problem of complacency from two sides, as a businessman and as a supplier of products to American industry.

It takes a unique person to always be on the lookout for better ways

to make products that are already successful. Doing this means constantly making improvements in response to customer needs or emerging market opportunities. It also means constantly looking for new and better ways to manufacture the products, a search that can become costly in the short run, and therefore potentially unattractive to business people with short-term profits in mind.

With me, if the new technology has the potential to improve quality, productivity or profit even a small amount, I'll buy it. For example, we spend hundreds of thousands of dollars on hardened steel grinding. So we're of the latest production technology, we have a very low scrap rate.

In the conflict between production and quality, there really isn't much problem for us. As I stated before, when there's a quality problem, production stops until the problem is resolved. Quality is the rule. I think we became more quality conscious many years ago when the Japanese showed us that we needed improvement. We were shipping Rotabroach Cutters to customers in Japan. They sent quite a few back, complaining that they weren't manufactured to print, nor were they functionally acceptable. They were applying quality standards in excess of ours in the United States. If we wanted to keep selling to these Japanese customers, we had to raise our standards. We did this, to the point where our quality now exceeds that of competing Japanese toolmakers.

We once experienced a more severe quality problem closer to home, but one that dramatically illustrates our determination to deliver only the highest quality tools. At one point several years ago, we had some bad welds on a tool we were making. We had them checked at a metallurgy firm, which said the welds were good. It wasn't until we had sold several thousand tools that we found how wrong the firm's findings were. The customers began complaining that one or two cutters out of every 10 or so were bad. We ended up taking them all back. We had no choice but to absorb the cost if we were going to preserve our reputation in the industry. The painful part was that we had customers who wanted the product, and we wouldn't sell to them until the quality problem was straightened out.

The problem resulted from a decision to use a lower quality, less expensive steel in the shaft part of the tool. The more expensive steel would be used only for the cutting edge. We used an outside firm to weld the cutting edge to the shaft. Unfortunately, the two pieces would sometimes separate. To avoid this, we had to make the tool from one piece of high-quality steel. Costs were higher, but it's been worth it. We're now sure we have a reliable product.

Such attention to quality has given us a valuable lead on the competition, but a lead we know can disappear overnight. Not everyone in American industry shares this sense of peril in the face of continued success.

We lead the world in manufacturing of hole-making technology. We have the best hole cutting tools on the market. We're the largest manufacturer of magnetic drills in the country. We think our magnetic drills are the safest in the world. I kept my more powerful drills off the market until they were as safe as possible to use. That's a more expensive approach, but one that has kept us ahead of the competition.

Does that make it any easier to sell our hole-making equipment to American industry? Not at all. We run into the same walls of indifference that have affected others with innovative ideas over the past 40 years. Suddenly the competitive battle has heated up, but not to the point where innovation is readily embraced in most traditional American industrial firms. The indifference problem has a number of origins. One bears closer scrutiny. Many manufacturing CEO's don't know they have a problem until it nearly consumes their organization. That's when we have a chance to get their attention - when the company is imperiled. Otherwise, representatives from small innovative companies like mine have only limited access to senior decision makers in the large industrial organizations. Top decision makers are busy men and women. Often, they assume you don't have something worth their attention, even though we know and tell them our products can do in minutes what now may take hours to complete.

How great is the potential in using innovative processes? A car maker's experience with a stainless steel manifold is an example. Engineers at the company were trying to save weight and increase performance with the stainless steel part. But the designers of the part didn't take into consideration the problems that would be encountered cutting the holes in the stainless steel on a production basis. Cutting these holes with the conventional technology only allowed a small percentage of the daily production schedule to be met. They had to be cut on an angle, something that twist drills could not do. Someone in the plant had heard of us, so we were called in. We looked at the job and realized a Rotabroach could be adapted to the process. But we knew it would take more than just a standard tool. We were entering round surfaces at an angle. We could cut the holes quickly. But we were getting an oddly shaped slug that couldn't be ejected by the Rotabroach. We solved the problem by

changing the inside surface of the cutting tool in the way that cut the slug smaller. It took me about a week of steady thought to come up with the solution and I'm not talking 40 hours but more like 70 or more. But the method was patented and we have been reaping the benefits of that hard work for years.

That change made our cutting process quick and efficient. The laser machine considered by the customer cost something like a million dollars and was slower than our process. Our approach got the auto assembly line going again, with greater efficiency and lower cost. Unfortunately, the customer didn't see fit to adapt our technology to other manufacturing problems. We had solved the immediate problem and that was that.

We see this kind of tunnel vision frequently. It happens often at the many manufacturing shows we attend. We go to shows year after year. Thousands of people walk past our booth, watching us use Rotabroach Cutters to cut through 2-inch steel plates in seconds. People get excited at the process, but then say they don't need it because they're not having problems with their drilling operations at the moment. They won't be in the mood to examine new processes until the competition passes them, and by then it may be too late. Sometimes I would demonstrate tools to customers and then wouldn't hear from them for a year or more, until a drilling machine broke down, or the competition moved ahead and change was unavoidable. In a crisis, our more efficient processes started looking more appealing.

It's a sad condition when big American industrial organizations are so closed to new ideas. The only solution I can think of is for senior managers to train themselves and their subordinates in new ways of thinking.

Part of it is perspective. As I related earlier, when I developed the Rotabroach I wasn't looking for a better way to make a twist drill. I looked at how to manufacture a better hole. The twist-drill process, no matter how sophisticated the cutting might be, will always take a lot of horsepower because all the material in the hole is cut into chips.

To be innovative, you have to challenge the way everything is done and made. When I was developing my tools for manufacturing holes, I concentrated on the challenge at hand for 10 or 12 hours a day, questioning all my assumptions about making holes. I used the same approach in developing a frame machine for straightening car frames and bodies. I made my product unique in design and taught a new concept in the automotive repair industry. I would personally sell six

or seven of the frame straighteners to body shops each day. I knew the machine; after all I developed it.

I could demonstrate it, answer questions and teach customers how to use it to maximum efficiency. If the customer didn't want to take the time to learn about my product, I'd just come back, often on Saturdays or near closing time, when business was slow. Finally, the owner would let me put on a demonstration, and that would almost always clinch the sale.

I wish I knew why it's so hard to get people to try new tools and methods they really need. I'd have a hundred million dollar business if I did. Once we get a product in place in some industries, the word gets around. We found this in the construction industry with our magnetic drills. But construction is a little like body repair, lots of little operations, usually run by the owner. Getting through to the huge multi-national corporations is much harder.

Efficiencies are everywhere, waiting to be swept up by the astute, open-minded businessperson. It's like picking up free money off the floor. Consider the construction material industry, which fabricates steel beams. Often, a worker has to cart a heavy piece of metal through the plant to a drill press, then take it somewhere else for rustproofing, welding or shipping. With a magnetic drill and a 3-inch Rotabroach, they could cut that same hole on-site.

The Rotabroach can do things other hole technology can't touch. For example, a customer was having problems punching precision holes in cast aluminum automobile wheels. Not surprisingly, cracks would sometimes occur during the process. We showed how the holes could be cut with Rotabroach Cutters as quickly as they could be punched, with no chance of fracture. Production and quality improved immediately, and the product was safer to use on customers' cars.

I think we are at the point where American industry is beginning to look seriously at our tools and other forms of innovative technology. More decision-making people are appearing at the manufacturers shows. Business leaders are starting to realize they must modernize to compete. Some are going through their plants and looking for any place where Rotabroach Cutters and other innovative processes can be adapted profitably.

We are more than ready to support this search. Many times we have to build special tools for special applications. We consider this part of the service, with the customer as the beneficiary.

In some cases, jobs that took hours can be done in minutes. For example, cutting say a 2-inch hole in metal with limited horsepower would ordinarily mean drilling a small hole, then a larger one and

finally one that takes out the full 2-inch diameter. We can place one of our tools on the job and cut the hole cleanly in one pass. Such improvement can cause customers to search for other efficiencies. Once the process of innovation begins, it shouldn't end. With the money to be saved, there's no reason for it to.

Conclusion

Because I am so convinced everyone has the ability to be an inventor I'd like to repeat some important points in conclusion on how to go about it.

Challenge the accepted. Look hard at how things are presently being done, then try to imagine every other way possible to get the same of better results. Look for things that could be improved preferably, but not necessarily, in an area most familiar to you. If you are a plumber, for example, it stands to reason you might have an idea for an improvement in that field; a homemaker might have a better idea for stacking pots and pans or a better cleaning tool, or a toy etc. There's room for improvement everywhere - always.

After you're convinced you have a better tool or method in mind, make that your number one thought. Let your imagination take over. Let your mind wander about the idea to the point where you seem to be considering fantasy. People probably thought the concept of the light bulb was ridiculous in Thomas Edison's day. The point I can't stress enough is to stick to the thought. Keep it with you always, so you can go over and over it, challenging, revising and honing as you go along.

Think about the problem and every conceivable solution, alternative or new method. Don't let it slip away from your conscious thought for any extended period of time. It should be like when you fall in love, your loved one is rarely out of your mind. Think about it when you're falling asleep, in your sleep and as soon as you awaken. This kind of concentration will take practice, but it's a trait that anyone who truly wants to can develop - and an essential quality for an inventor.

I would like to have a dollar for every time I've been accused of not being mentally where I'm supposed to be, for example, at a cocktail party or wherever. I can't count the times my wife has complained, "you haven't heard a thing I've said." I often find myself making up for this lack of attention before the evening ends, though, which brings me to another point.

Making love stimulate my creative genes. I have noticed I can

frequently finalize an invention I have been working on, or even come up with a totally new idea after making love. This phenomenon does not seem to be coincidental since it has happened many times during my career and still continues to happen today. I'm not sure this would be a good idea to try every time you're looking for a solution to a problem, but it sure makes inventing fun. How many times have you heard someone say he thought of a new product long before he actually saw it on the market? I know I have and most others have as well. To me, this is a clear example of someone having an inventive idea and not following through. Follow-through is the hardest thing to do. Take your inventive idea and follow it through to a conclusion. Don't ever give up without knowing it won't work.

Here is an example of the inventive process I am describing and how it works for me.

The problem (or opportunity) came up when I noticed that most body repair shops mixed paint the way you do at home - with a stick. Paint shakers were available at the time but were too expensive for the average shop.

I started thinking about paint shakers and how they work. The ones I analyzed looked like they were about to self-destruct with the violent shaking action they produced. And they were large, heavy, strong and powerful contraptions that had to be bolted securely into place. These factors caused the expense of the product.

What the average body and paint shop needed was a shaker that had a good mixing action, but at the same time was light and didn't have to be bolted down. They needed something designed specifically for the body shop market. Since 80 percent of paint containers used are pints and quarts, not gallons, I decided to design a shaker for only pints and quarts. Less violent shaking action would be necessary for the smaller container. Another consideration was my new shaker would not have to do its work as fast as one in a paint store. There the customer is waiting there, while in a body shop, the workers generally know well in advance when they will need the paint.

Having determined what was needed, I started the thinking process. The big problem was reducing the self-destructing, violent motion. So I concentrated my thought on how I could tame the action or use a different motion and still have a good mixing process. I had to let my mind wander - conceivable movement that would attain the desired result.

Eureka! All of a sudden the solution came to me.

I would mount the shaker on four coil-type springs. The springs

would soften the violent action and add a new oscillating, dancing-type movement. Imagine how far I had to stretch my imagination to come up with putting springs on a paint shaker.

Now was the time to work with a design engineer and reduce the concept to practice. It was time to build one. Working closely with a spring manufacturer who furnished various springs that might work, we experimented with my new design. The company didn't charge for designing new springs because it wanted the business if the tool worked.

After about six weeks, I had a prototype shaker that weighed about 30 pounds, danced on the springs, stayed in one spot without being bolted down and would sell at a price that small shops could afford. After we had sold tens of thousands of my new invention, one of our employees came up with an even better shaker, still using the spring concept. His shaker uses four sets of springs instead of two and can shake gallons as well as pints and quarts and is only slightly more expensive. His shaker is now in the patenting process.

I firmly believe if the general public had the opportunity to read this book and would give inventing a sincere try, twice the number of inventors would exist. If what I say is true, imagine what it would do for you and our country. Imagine how life could be improved if chemists, physicists, engineers, mathematicians, business people, mechanics, housewives and other believed they could invent and actually did instead of considering inventing a rare gift bestowed only on a chosen few.

Many of your ideas will seem too far-fetched to you. But remember how far I had to reach and let me imagination wander to come up with springs on a paint shaker and how ludicrous it seemed. But, by taking hold of that idea, letting my mind wander over the adjustments that could be made, the concept no longer sounds so silly. The challenge was met and the problem solved.

I am living proof many people could be successful inventors if they, like me, believed when they were told they could invent. Think about it, I was 35 years old when a colleague convinced me. I felt I was creative or had inventive tendencies, but never to the extent that I could make a living from it. All humans are creative and/or inventive, some to a greater extent than others. You could very well be one of the hundreds of thousands of potential successful inventors. Believe in yourself and give it a real effort. The rewards are worth it. Every human being is blessed with a certain amount of creativity and imagination. Imagine yourself as an inventor; have high self-esteem and self-confidence. Know you can and will find a solution if you

will only try. Persist - very few solutions are flash revelations. I have yet to have one. More often, they are the result of hundreds or thousands of hours of concentrated effort. I also believe you don't have to be exceptionally clever or bright to be a prolific inventor. The most important points to remember are persistence and believing in yourself and both of those traits can be acquired.

Don't be afraid of failure. I have never invented anything without making many mistakes. One failure after another is common, but the trick is to learn from them and don't be discouraged because success is just around the corner.

Challenge all ideas and methods. Even the traditional, the accepted and the proven.

Now just a few more thoughts about what I've learned in more than 50 years of thinking about manufacturing processes and how to make money by improving them.

American industry is in a serious competitive struggle, of that there seems little doubt. Is this bad? I don't think so. Rather, I think the struggle has been overdue. An odd combination of factors put American manufacturers in an unrealistic position in the years immediately following World War II. Our nation had vast natural resources and an industrial capacity that had been expanded by the war, not destroyed by it. American manufacturers often made money simply by producing as much as possible. Most of what was made had ready assurance of a market.

Those days have ended with wrenching suddenness for a generation of managers who rose to positions of power and wealth through devotion to the gospel of production. For them, quality and safety would often be given secondary consideration, if that were considered at all. Now quality and customer satisfaction are everything. The manufacturers who want to survive in today's world competitive arena must devote themselves to the gospel of quality.

To my thinking, that means adherence to a philosophy of constant improvement. America's industrial leaders must be on constant lookout for new ideas that will keep them abreast of their competition. They must create and nurture management processes for their plants and offices that encourage and reward employee ideas and commitment. And they must invent management processes that identify and implement the best ideas and technologies available outside the plants.

American business leaders must outgrow the notion of "Great Leaps Forward." No longer can they devote their best efforts and ideas to the preservation of a status quo that they think is rewarding them

handsomely. With such an approach, under today's competitive circumstances, those rewards aren't likely to last long. The notion must be dispelled that a company can lag behind the competition, then catch up later through a massive reorganization of jobs and people. Such a management style is inhumane and, in today's environment, probably ineffective.

Ideas make the difference, ideas and inventive people to develop and use them. I've lived my professional life on the basis of that belief. I hope my story inspires others to live that way too. The world of ideas can be fun, and very rewarding.

My father and I in about 1917.

My mother, Corrine (C.B.) Brillon Haugen with Dee and myself in about 1920.

Me on the left with my brother Donald in front of our Canada home , about 1920.

Maurice Christiansen, one of my first employees and long time friend with myself.

Me today checking the quality of a couple of new Rotabroaches.

At eight years old, I led "Billy" home with bread on a pole.

Douglas Spencer, Teri and I in front of our home on Blair Street.

Douglas Spencer and his wife Pat on a family cruise.

Louis Oscar Hougen, my father, was an entrepreneur. He died at the young age of 53.

The family on a cruise , New Years 1989.

The Hougen business in Florida.

An artists rendering of our plant in Flint.

Our home in Saskatchewan.

Me as a toddler.

Teri and I on our wedding day in 1941.

Front row; Lenaer, Jackie, Teri and myself.
Back row; Randall, Bradley, Victor and Renee' in 1989.

1989 family cruise.

"This book, coming from a prolific inventor and successful businessman, should be an inspiration to all. Reading it will help a novice to think inventively and an inventor to think pragmatically. Blessed are those for whom inventing is a way of life."

Tirupathi R. Chandrupatla, Professor
GMI Engineering & Management Institute

"Great Book! Doug Hougen's story is that of the independent American inventor of the 20th century. Unheralded in our history books and overlooked by our mass media, they are the underpinnings of our economy and our principal strength and advantage as we face an increasingly competitive global marketplace. This book will encourage others to recognize and utilize their creative talents, and perhaps, in some small way, to further this country's recognition of its most valuable resource."

Edward Zimmer, Editor
Inventor-Entrepreneur Network

"With over twenty years' experience as a patent attorney, I can say with authority that there are few true inventors. Inventor Doug Hougen sees technical problems as opportunities. He started by looking at the hole and now has over 30 U.S. patents on drills. I had believed it was impossible to teach the art of inventing until I read Doug's book."

Raymond E. Scott
Patent Attorney